

Listing of the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application.

1. (Currently Amended) A microporous film comprising at least one layer comprising a polymer blend comprising:

(i) a first polymer comprising a high density polyethylene;

(ii) a second polymer comprising a polypropylene ~~polyolefin~~; and,

(iii) an effective amount of a polymeric compatibilizer comprising an ethylene/ α -olefin interpolymers having one or more of the following characteristics:

(a) a M_w/M_n from about 1.7 to about 3.5, at least one melting point, T_m , in degrees Celsius, and a density, d , in grams/cubic centimeter, wherein the numerical values of T_m and d correspond to the relationship:

$$T_m > -2002.9 + 4538.5(d) - 2422.2(d)^2, \text{ or}$$

(b) a M_w/M_n from about 1.7 to about 3.5, and is characterized by a heat of fusion, ΔH in J/g, and a delta quantity, ΔT , in degrees Celsius defined as the temperature difference between the tallest DSC peak and the tallest CRYSTAF peak, wherein the numerical values of ΔT and ΔH have the following relationships:

$$\Delta T > -0.1299(\Delta H) + 62.81 \text{ for } \Delta H \text{ greater than zero and up to } 130 \text{ J/g,}$$

$$\Delta T \geq 48^\circ\text{C for } \Delta H \text{ greater than } 130 \text{ J/g,}$$

wherein the CRYSTAF peak is determined using at least 5 percent of the cumulative polymer, and if less than 5 percent of the polymer has an identifiable CRYSTAF peak, then the CRYSTAF temperature is 30°C ; or

(c) is characterized by an elastic recovery, R_e , in percent at 300 percent strain and 1 cycle measured with a compression-molded film of the ethylene/ α -olefin interpolymers, and has a density, d , in grams/cubic centimeter, wherein the numerical values of R_e and d satisfy the following relationship when the ethylene/ α -olefin interpolymers is substantially free of a cross-linked phase:

Re>1481-1629(d); or

(d) has a molecular fraction which elutes between 40°C and 130°C when fractionated using TREF, characterized in that the fraction has a molar comonomer content of at least 5 percent higher than that of a comparable random ethylene interpolymer fraction eluting between the same temperatures, wherein said comparable random ethylene interpolymer has the same comonomer(s) and has a melt index, density, and molar comonomer content (based on the whole polymer) within 10 percent of that of the ethylene/ α -olefin interpolymer; or

(e) has a storage modulus at 25°C, $G'(25^\circ\text{C})$, and a storage modulus at 100°C, $G'(100^\circ\text{C})$, wherein the ratio of $G'(25^\circ\text{C})$ to $G'(100^\circ\text{C})$ is in the range of about 1:1 to about 9:1; or

(f) has at least one molecular fraction which elutes between 40°C and 130°C when fractionated using TREF, characterized in that the fraction has a block index of at least 0.5 and up to about 1 and a molecular weight distribution, M_w/M_n , greater than about 1.3; or

(g) has an average block index greater than zero and up to about 1.0 and a molecular weight distribution, M_w/M_n , greater than about 1.3 or

(h) has a M_w/M_n from about 1.7 to about 3.5 and has at least one melting point, T_m , in degrees Celsius, and a density, d , in grams/cubic centimeter, wherein the numerical values of T_m and d correspond to the relationship:

$$T_m > -6553.3 + 13735(d) - 7051.7(d)^2.$$

2. Canceled.

3. (Withdrawn) The microporous film of claim 1, wherein the second polymer is selected from the group consisting of low density polypropylene (LDPP), high density polypropylene (HDPP), high melt strength polypropylene (HMS-PP), high impact polypropylene (HIPP), isotactic polypropylene (iPP), syndiotactic polypropylene (sPP) and a combination thereof.

4. (Withdrawn) The microporous film of claim 1, wherein the first polymer comprises a high density polyethylene (HDPE) and the second polymer comprises a low density polyethylene (LDPE) or a linear low density polyethylene (LLDPE).

5. (Withdrawn) The microporous film of claim 1, wherein the first polymer comprises a high density polyethylene (HDPE) and the second polymer comprises an ethylene copolymer having a composition distribution breadth index CDBI of greater than 50%.

6. (Withdrawn) The microporous film of claim 1, wherein the second polymer is a vulcanizable rubber.

7. (Original) The microporous film of claim 1 having a first non-coextruded portion, and a second non-coextruded portion, said first portion being bonded directly to said second portion, said bond having a strength greater than 5 g/in, and said first portion and said second portion being made of the same material and being oriented in substantially the same direction; and said film having a thickness less than 1.5 mils, a Gurley number of less than 50 sec/10 cc, and a puncture strength of greater than 400 g/mil.

8. (Original) The microporous film of claim 1, wherein the first polymer comprises a high density polyethylene copolymer which has a melt index (MI) of 0.1 to 100 and a content of an alpha-olefin unit with 3 or more carbon atoms of 0.1 to 1% by mole; a high density polyethylene which has a viscosity average molecular weight (Mv) of at least 500000 to 5000000, wherein the blend has an Mv of 300000 to 4000000 and a content of an alpha-olefin unit with 3 or more carbon atoms of 0.01 to 1% by mole.

9. (Original) The microporous film of claim 1 wherein the polymers are functionalized.

10. (Original) The microporous film of claim 1 wherein the compatibilizer is present in an amount of about 2 weight percent to about 15 weight percent.

11. (Original) The microporous film of claim 1 wherein the film does not comprise plasticizers.

12. (Original) The microporous film of claim 1 wherein the film comprises pores having a size in the range of from about 0.02 microns to about 10 microns.

13. (Original) The microporous film of claim 1 further comprising an additional layer.

14. (Original) The microporous film of claim 13, wherein the additional layer has the same, similar or different porosity than the at least one layer.

15. (Original) The microporous film of claim 13 wherein the layers are laminated.

16. (Original) The microporous film of claim 13 wherein the layers are laminated to a nonwoven layer.

17. (Original) The microporous film of claim 1 further comprising a ceramic layer.

18. (Original) The microporous film of any claim 1 further comprising a heat resistant layer.

19. (Currently Amended) A separator comprising a microporous film comprising:

(i) a first polymer comprising a high density polyethylene;

(ii) a second polymer comprising a polypropylene; and

(iii) an effective amount of a polymeric compatibilizer comprising: an ethylene/ α -olefin multi-block interpolymer having one or more of the following characteristics:

(a) a M_w/M_n from about 1.7 to about 3.5, at least one melting point, T_m , in degrees Celsius, and a density, d , in grams/cubic centimeter, wherein the numerical values of T_m and d correspond to the relationship:

$$T_m > -2002.9 + 4538.5(d) - 2422.2(d)^2, \text{ or}$$

(b) a M_w/M_n from about 1.7 to about 3.5, and is characterized by a heat of fusion, ΔH in J/g, and a delta quantity, ΔT , in degrees Celsius defined as the temperature difference between the tallest DSC peak and the tallest CRYSTAF peak, wherein the numerical values of ΔT and ΔH have the following relationships:

$$\Delta T > -0.1299(\Delta H) + 62.81 \text{ for } \Delta H \text{ greater than zero and up to } 130 \text{ J/g,}$$

$$\Delta T \geq 48^\circ\text{C for } \Delta H \text{ greater than } 130 \text{ J/g,}$$

wherein the CRYSTAF peak is determined using at least 5 percent of the cumulative polymer, and if less than 5 percent of the polymer has an identifiable CRYSTAF peak, then the CRYSTAF temperature is 30°C ; or

(c) is characterized by an elastic recovery, Re , in percent at 300 percent strain and 1 cycle measured with a compression-molded film of the ethylene/ α -olefin interpolmer, and has a density, d , in grams/cubic centimeter, wherein the numerical values of Re and d satisfy the following relationship when the ethylene/ α -olefin interpolmer is substantially free of a cross-linked phase:

$$Re > 1481 - 1629(d); \text{ or}$$

(d) has a molecular fraction which elutes between 40°C and 130°C when fractionated using TREF, characterized in that the fraction has a molar comonomer content of at least 5 percent higher than that of a comparable random ethylene interpolmer fraction eluting between the same temperatures, wherein said comparable random ethylene interpolmer has the same comonomer(s) and has a melt index, density, and molar comonomer content (based on the whole polymer) within 10 percent of that of the ethylene/ α -olefin interpolmer; or

(e) has a storage modulus at 25°C, $G'(25^\circ\text{C})$, and a storage modulus at 100°C, $G'(100^\circ\text{C})$, wherein the ratio of $G'(25^\circ\text{C})$ to $G'(100^\circ\text{C})$ is in the range of about 1:1 to about 9:1; or

(f) has at least one molecular fraction which elutes between 40°C and 130°C when fractionated using TREF, characterized in that the fraction has a block index of at least 0.5 and up to about 1 and a molecular weight distribution, M_w/M_n , greater than about 1.3; or

(g) has an average block index greater than zero and up to about 1.0 and a molecular weight distribution, M_w/M_n , greater than about 1.3 or

(h) has a M_w/M_n from about 1.7 to about 3.5 and has at least one melting point, T_m , in degrees Celsius, and a density, d , in grams/cubic centimeter, wherein the numerical values of T_m and d correspond to the relationship:

$$T_m > -6553.3 + 13735(d) - 7051.7(d)^2.$$

20. (Currently Amended) A fabricated article comprising a microporous film comprising:

(i) a first polymer comprising a high density polyethylene;

(ii) a second polymer comprising a polypropylene; and

(iii) an effective amount of a polymeric compatibilizer comprising an ethylene/ α -olefin interpolymers, having one or more of the following characteristics:

(a) a M_w/M_n from about 1.7 to about 3.5, at least one melting point, T_m , in degrees Celsius, and a density, d , in grams/cubic centimeter, wherein the numerical values of T_m and d correspond to the relationship:

$$T_m > -2002.9 + 4538.5(d) - 2422.2(d)^2, \text{ or}$$

(b) a M_w/M_n from about 1.7 to about 3.5, and is characterized by a heat of fusion, ΔH in J/g, and a delta quantity, ΔT , in degrees Celsius defined as the temperature difference between the tallest DSC peak and the tallest CRYSTAF peak, wherein the numerical values of ΔT and ΔH have the following relationships:

$$\Delta T > -0.1299(\Delta H) + 62.81 \text{ for } \Delta H \text{ greater than zero and up to } 130 \text{ J/g,}$$

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wherein the CRYSTAF peak is determined using at least 5 percent of the cumulative polymer, and if less than 5 percent of the polymer has an identifiable CRYSTAF peak, then the CRYSTAF temperature is 30°C ; or

(c) is characterized by an elastic recovery, Re , in percent at 300 percent strain and 1 cycle measured with a compression-molded film of the ethylene/ α -olefin interpolymers, and has a density, d , in grams/cubic centimeter, wherein the numerical values of Re and d satisfy the following relationship when the ethylene/ α -olefin interpolymers is substantially free of a cross-linked phase:

$$Re > 1481 - 1629(d); \text{ or}$$

(d) has a molecular fraction which elutes between 40°C and 130°C when fractionated using TREF, characterized in that the fraction has a molar comonomer content of at least 5 percent higher than that of a comparable random ethylene interpolymers fraction eluting between the same temperatures, wherein said comparable random ethylene interpolymers has the same comonomer(s) and has a melt index, density, and molar comonomer content (based on the whole polymer) within 10 percent of that of the ethylene/ α -olefin interpolymers; or